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ASSESSING A SPECIFIC MEASURE OF SOPITE SYNDROME: THE MILD MOTION QUESTIONNAIRE

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The sopite syndrome is characterized by motion-induced drowsiness. However, little is know about this unique response to motion. The Mild Motion Questionnaire was developed in an effort to quantify sopite syndrome. The goal of the current study was to test the construct validity of the questionnaire to distinquish the symptomology from that of boredom or inattention. Thus, a sample of 456 undergraduate students completed the Mild Motion Questionnaire, the Boredome Proness Scale, and the Adult Attention Deficit/Hyperactive Disorder Checklist. Results suggested divergence of sopite from the other scales. Conversely, the measures of boredom proneness and attention deficit/hyperactive disorder were related. Interpretations and implications for performance and human error in operational settings are discussed as well as implications for performance and human error in operational settings.

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Abstract

The sopite syndrome is characterized by motion-induced drowsiness. However, little is know about this unique response to motion. The Mild Motion Questionnaire was developed in an effort to quantify sopite syndrome. The goal of the current study was to test the construct validity of the questionnaire to distinquish the symptomology from that of boredom or inattention. Thus, a sample of 456 undergraduate students completed the Mild Motion Questionnaire, the Boredome Proness Scale, and the Adult Attention Deficit/Hyperactive Disorder Checklist. Results suggested divergence of sopite from the other scales. Conversely, the measures of boredom proneness and attention deficit/hyperactive disorder were related. Interpretations and implications for performance and human error in operational settings are discussed as well as implications for performance and human error in operational settings.

INTRODUCTION

Everyone experiences feelings of drowsiness almost every day of their life. Granted the intensity of drowsiness varies among all of us, it is usually welcomed when we are free to take time to rest or sleep. However, if rest is not acquired, performance can be adversely affected. Thus, fatigue is of great concern for vehicle operators such as pilots. For example, Charles Lindbergh almost failed to complete his flight from New York to Paris due to drowsiness. He fell asleep over the Atlantic Ocean and awoke to find his plane spiraling towards the water. Fortunately, he was able to recover from his lapse into sleep and complete his history-making flight (Graeber, 1988). While falling asleep at the controls of a vehicle is of great concern, the effects of fatigue (e.g., drowsiness, lethargy) can also jeopardize vehicle safety, even when sleep does not occur.

It is a commonly held belief that mild motions such as those experienced when rocking in a chair or riding in an airplane can induce drowsiness. Reason (1974) stated that the "repetitive vestibular stimulation produced by the motion of a vehicle acts on the central nervous system much like a sleeping pill" (p. 181). Graybiel and Knepton (1976) coined the phrase 'sopite' to describe this "sometimes sole manifestation of motion sickness" (p. 873), which is characterized by such symptoms as motion-induced drowsiness, apathy, and difficulty concentrating (Lawson, Graeber, Mead, & Muth, 2002). The term 'sopite' is derived from the Latin word *sopire*, which means to 'lay to rest' or 'put to sleep.' One of the earliest observations of the syndrome came about as a result of a study conducted by Graybiel et al. (1965) in which military aviation students were required to live aboard a rotating room for 12 days. Participants were highly motivated at the beginning of the study. However, complaints of fatigue and drowsiness were common, even with sufficient sleep during the 12-day period of rotation. Additionally, participants displayed minimal motivation and spent a majority of their free time in solitude or resting (i.e., sleeping). Participants also restricted their head movements (and hence their vestibular stimulation) long after recovering from nausea, which indicated the presence of something other than motion sickness.

Graybiel and Knepton (1976) identified several symptoms of sopite syndrome: drowsiness, difficulty concentrating, apathy, mental depression, disinclination for work, irritability, and sleep disturbance. While some might argue that these symptoms result solely from motion sickness, Lawson and Mead (1998) state that when the criteria of Miller and Graybiel (1974) are used, the only shared symptom between the two constructs is drowsiness. Symptoms of sopite (see above) are believed to be a vestibular reaction to motion (Reason, 1974), much like the milder feelings one experiences when moving to and fro in a swing or rocking chair. Therefore, sopite is of concern in any situation involving vehicle operation (e.g., airplanes, helicopters, buses). While many military pilots are aware of the effects of motion sickness during flight, few are aware of the hidden dangers of sopite. Sopite-like symptoms, such as fatigue, may negatively influence performance in aerospace environments (Graeber, 1988), as well as other motion environments (e.g., ships, trucks) (Graybiel & Knepton, 1976).

Although Gianaros, Muth, Mordkoff, Levine, and Stern (2001) include a sopite dimension in their Motion Sickness Assessment Questionnaire, no other measures specific to sopite currently exist. Lawson, Kass, Muth, Sommers, and Guzy (2001) developed the Mild Motion Questionnaire (MMQ) to identify those individuals experiencing the effects of sopite. The scale was developed using descriptors that were generated by 571 participants (116 were US military aviation students and 455 were college undergraduates). A factor analysis of the MMQ identified four symptom dimensions: (1) Head/Body, (2) Relaxed/Content, (3) Drowsy/Fatigue, and (4) Poor Concentration/Motivation. The Head/Body factor refers to 'head' symptoms of motion discomfort (e.g., headache, dizziness, light-headedness, blurred vision), incoordination, imbalance, disorientation, and stomach awareness. The Relaxed/Content factor is indicative of feeling calm, peaceful, relaxed, and content. The Drowsy/Fatigue factor relates to feelings of sleepiness or fatigue, and the Poor Concentration/Motivation factor refers to descriptors such as lethargy, decreased motivation, decreased concentration, and decreased willingness to communicate.

To validate the MMQ and show it is measuring the intended construct, we needed to demonstrate that the scale was not merely assessing other individual characteristics that may mimic sopite symptoms. We were concerned that individuals who were especially prone to the effects of boredom or who suffer from disorders of attention might be mistakenly assessed as suffering from sopite syndrome.

BOREDOM PRONENESS

Boredom is defined as "a state of relatively low arousal and dissatisfaction that is attributed to an inadequately stimulating environment" (Mikulas & Vodanovich, 1993, p. 3). Some individuals are more likely to be affected by the antecedents of boredom, and hence the trait of boredom proneness (BP) has been identified as a predisposition for the state of boredom (Farmer & Sundberg, 1986).

Beaty (1995) reported that boredom has been linked to numerous aviation accidents. For example, in 1973 a DC-10 flight crew became bored as the automatic pilot flew the plane, thereby reducing their attention towards flying the aircraft. As a result, the crew began searching out additional stimulation to combat the restlessness and fatigue that accompanied their boredom. The flight engineer and pilot became interested in a particular control instrument with which they were unfamiliar and proceeded to activate the switch. This caused an internal explosion in the starboard engine, sending shrapnel airborne and causing a window to break, which resulted in a passenger being sucked out of the plane. While aircraft automation has helped pilots a great deal, some of the automation (e.g., auto-pilot) has resulted in a substantial decrease in pilot activity and control in flying an aircraft, which in turn might increase the chances of a pilot becoming bored (Beaty, 1995).

Several researchers have found that boredom and performance on tasks requiring sustained attention are negatively related (e.g., Kass, Vodanovich, Stanny, & Taylor, 2001; Monteil & Fayol, 1997). Kass et al. (2001) demonstrated that BP scores predicted performance for the initial 10 min of the Mackworth Clock Test. Sawin and Scerbo (1995) found that scores on the Boredom Proneness Scale (BPS) are negatively related to performance on a flicker detection task.

Because individuals may suffer from boredom during long flights or car rides, we believe the effects of boredom (e.g., sleepiness, lack of concentration) may be confused with those caused by mild motion. Additionally, both constructs share a negative relationship to performance, and boredom has been blamed for several aviation accidents (see Beaty, 1995). Although these two constructs share some similarities, BP factor scores should account for only a fraction of the variance in sopite factor scores if the latter construct is valid. Specifically, the relationship between constructs should be greatest for the shared reactions to both boredom and sopite (i.e., lack of concentration, motivation, drowsiness) and minimal or nonexistent otherwise.

ATTENTION DEFICIT/HYPERACTIVE DISORDER

Whether or not boredom is present, some people have more difficulty paying attention than others. Attention Deficit/Hyperactive Disorder (ADHD) is a disorder that affects all age groups and constitutes deficits in attention and behavior inhibition (Barkley & Murphy, 1998). Due to the inability to attend, individuals with ADHD have difficulty performing in educational and work settings (Weiss, Hechtman, & Weiss, 1999). ADHD is associated with a host of negative outcomes including driving accidents (Barkley, 1997; Nadeau, 1995) and job performance (Barkley & Murphy, 1998). A negative relationship between ADHD and performance on attention tasks (e.g., Stroop task) has also been found (Shaw & Giambra, 1993). The negative relationship between ADHD and performance is strengthened if the task is perceived as boring (Douglas, 1983). Inattention has also been blamed for several aviation accidents (see Beaty, 1995).

The relationship between Sopite Syndrome and ADHD has not been examined to date. Although we expect some similarity between ADHD and the Poor Concentration/Motivation factor of the MMQ, we expect that ADHD scores will only account for a small amount of the variance in the other factors contributing to the assessment of sopite because ADHD is comprised of deficits in attention and not other factors related to sopite (i.e., head body symptoms, relaxed/content, drowsy/fatigue).

METHOD

PARTICIPANTS

Participants were 456 undergraduate students who participated in the study in exchange for extra credit in their coursework. They were recruited from two universities: a small university in the Southeastern United States and a

larger one in the Northeast. Participant age ranged from 18 to 54 with a mean of 21.8 years (SD = 6.6). Of the 456 participants, 283 were female (62.1%) and 173 were male (37.9%). The ethnicity of the sample was 81.8% Caucasian, 4.6% African-American, 4.2% Asian-American, and 5.3% Hispanic. The remaining 4.1% did not disclose their ethnicity. Almost half of the sample (49.7%) reported that they had previously experienced motion sickness although not necessarily to the point of vomiting.

MEASURES

Mild Motion Questionnaire

The MMQ (coefficient alpha = .92) was developed to identify individuals suffering the effects of sopite syndrome (Lawson et al., 2001). The questionnaire (see appendix) is comprised of 39 items and follows a 5-point Likert format (e.g., 1 = not at all, 5 = very strongly). The current study attempted to add construct validity to the MMQ. As mentioned and described previously, the MMQ consists of four dimensions: Head/Body Symptoms, Relaxed/Content, Drowsy/Fatigue, and Poor Concentration/Motivation.

Boredom Proneness Scale

The Boredom Proneness Scale (Farmer & Sundberg, 1986) follows a 28-item 7-point Likert format (1 indicates high disagreement 7 indicates high agreement) that has been altered from the original true/false format. This was done to improve the sensitivity of the scale (Vodanovich & Kass, 1990). Test-retest reliability of the BPS was found to be .83 within an interval of 1 week (Farmer & Sundberg, 1986). Coefficient alpha for the scale is .84 (Watt & Ewing, 1996).

Vodanovich and Kass (1990) identified five dimensions of the BPS. External Stimulation relates to the perceived need for externally exciting stimulation, whereas Internal Stimulation refers to a deficit in one's ability to create mentally entertaining stimuli. The third factor, Affective Response, refers to negative emotional responses to boredom such as anger or frustration. The Constraint subscale of the BPS has to do with a person's reactions to waiting (e.g., impatience). Lastly, the Perception of Time subscale contains items that are related to the perceived slowness of time.

Adult Attention Deficit/Hyperactive Disorder Checklist

The Adult Attention Deficit/Hyperactive Disorder Checklist (coefficient alpha = .98) was designed to assess a person's deficit in attention and inhibiting behaviors. Items on the checklist were gleaned from the diagnostic criteria put forth by the DSM-IV (American Psychological Association, 1994). The 100-item checklist utilizes a 7-point Likert format. A score of 1 represents low agreement with an item, and a score of 7 represents high agreement with an item. To date, no factors have been identified with this scale. Although several ADHD measures are available for children, this checklist was designed specifically for adults because only a handful of checklists are specifically designed for adults.

Procedure

Participants were asked to reflect upon instances of mild, nonsickening motion as experienced in a typical car, bus, train, or airplane ride or rocking in a swing. Participants then completed the MMQ, BPS, and ADHD checklist. Spearman rho correlations were computed among the scales and subscales.

RESULTS

Due to the large number of correlations among the scales and subscales in the study, the Bonferroni correction was used to control for experimentwise error rate. This rather conservative approach was taken to prevent any spurious correlations being identified as significant due to the large number of correlations being computed. The correction was implemented by taking the existing alpha level (.05) and dividing by half the number of correlations (144/2) as this is a two-tailed test. This resulted in the calculation .05/(144/2) = .0007. Therefore, the p value that was used to identify significance in the present study was $p \leq .0007$.

Total scale correlations are presented in Table 1. A weak, but significant, correlation was found between MMQ total scores and BP total scores (rho = .13, $p < .0007$). A relatively weak correlation was found between MMQ total scores and ADHD total scores ($rho = .21$, $p < .0007$).

Weak correlations were found among the factors of the MMQ and those of the BPS (see Table 1). The significant correlations were observed among the Poor Concentration/Motivation factor of the MMQ and the BP factors of External Stimulation ($rho = .22$, $p < .0007$) and Affective Response ($rho = .22$, $p < .0007$). Additionally, a weak correlation was found between MMQ Drowsy/Fatigue and BPS Perception of Time ($rho = .21$, $p < .0007$).

As expected, the MMQ subscale of Concentration/ Motivation was significantly related to ADHD scores ($rho = .23$, $p < .0007$) (see Table 1), demonstrating that although there is some similarity in constructs, one's assessment of attention deficit accounts for just 5% of the variance in MMQ Concentration/ Motivation scores. The constructs of boredom proneness and attention deficit were more highly related to one another than either was to sopite (see Table 1). Additionally, four of five BP factors were significantly related to ADHD.

DISCUSSION

The current study was undertaken to establish the construct validity of a new scale assessing the symptoms of sopite syndrome. The correlations observed in the study suggest that sopite syndrome may be distinct from BP and ADHD. While there were several significant correlations found among the scales and subscales, the majority of these relationships were weak. A few of the stronger correlations are addressed in the following discussion.

The correlations between MMQ Poor Concentration/Motivation and boredom suggest that a person who exhibits these may also perceive a need for more external stimulation and have an increase in emotional responses to boredom. Alternatively, being predisposed to boredom may adversely impact one's ability to concentrate. Whichever the case may be, this correlation suggests that a person suffering from both sopite and BP could be at risk for increased performance errors.

Generally, it appears that as a person's concentration decreases, the more prone to boredom the person might become. Perhaps the sopite symptoms associated with poor concentration and motivation (e.g., fatigue, drowsiness, and inattentiveness) are exacerbated by the additional effects of boredom in those who are particularly susceptible to sopite. However, these relations are weak and, as stated previously, there is a substantial lack of correlations between the MMQ and BPS scores. This suggests that the two scales might be measuring distinct constructs, which adds credibility to the divergent validity of the MMQ.

As previously mentioned, the positive correlation between MMQ Poor Concentration/ Motivation and ADHD was expected. As with the BPS/MMQ comparison, the lack of strong correlations between the MMQ subscales and ADHD checklist suggests that the measures are assessing somewhat different constructs. Nevertheless, the correlation between Sopite Concentration/Motivation and ADHD indicates some overlap between deficits in attention and poor concentration/motivation.

The correlations between BP and ADHD were significant for four of five subscales, which supports the conclusion of Wallace, Kass, and Stanny (2002). They found that ADHD persons might be more prone to boredom than non-ADHD persons, or they may suffer from boredom-related causes (e.g., uninteresting work/tasks), which might be one of the underlying sources of ADHD.

Boredom proneness (Kass et al., 2001) and ADHD (Shaw & Giambra, 1993) have been shown to be negatively related to performance. Likewise, one of the cardinal symptoms of sopite is a disinclination for work (Graybiel, Deane, & Colehour, 1969; Graybiel & Knepton, 1976), which might be expected to lead to performance decrements. Individuals scoring high on these measures may be at risk for increased numbers of performance errors, especially in mild motion environments. Possible remedies for these symptoms might include increasing environmental stimulation and reducing monotony to achieve greater levels of interest and attention. The error of the bored DC-10 flight crew, discussed previously, might have been avoided if the situation had required more active participation on the part of the flight crew. Another possible remedy that might be employed is the use of a drowsy operator detection and warning system (e.g., Rau, 2001). However, before possible remedies can be introduced, a better understanding of motion and sopite syndrome is necessary to properly develop and implement any such remedy.

Table 1. Intercorrelations Among Construct Factors

Scales and Subscales	1	2	3	4	5	6	7	8	9	10	11	12
1. MMQ[a] Total	--											
2. MMQ Head/Body	.75*	--										
3. MMQ Relax/Content	.00	-.44*	--									
4. MMQ Drowsy/Fatigue	.79*	.47*	-.14	--								
5. MMQ Poor Concen/Motiv[b]	.84*	.68*	-.28*	.66*	--							
6. BPS[c] Total	.13	.20*	-.18	.17	.19	--						
7. BPS External Stimulation	.14	.15	-.09	.12	.22*	.71*	--					
8. BPS Internal Stimulation	.08	.05	-.17	-.01	-.03	.54	.03	--				
9. BPS Affective Response	.18	.18	-.12	.19	.22*	.72*	.50*	.23*	--			
10. BPS Perception of Time	.16	.17	-.07	.21*	.18	.68*	.36*	.34*	.48*	--		
11. BPS Constraint	.04	.09	-.09	.07	.05	.44*	.20*	.19	.20*	.14	--	
12. ADHD[d]	.21*	.17	.02	.11	.23*	.53*	.48*	.08	.48*	.34*	.40*	--

[a]MMQ = Mild Motion Questionnaire
[b]Concen/Motiv = Concentration/Motivation
[c] BPS = Boredom Proneness Scale
[d]ADHD = Attention Deficit/Hyperactive Disorder
*Bonferroni Correction: $p < .05 / 72 = .0007$

The development and validation of the MMQ is an important step in this direction, and the questionnaire has shown promise in obtaining this goal.

The relationship among the scales and subscales examined in the present study provide a better understanding of sopite syndrome, BP, and ADHD, and support the claim that sopite is a distinct construct. Additional research is needed in which the two major symptoms of ADHD (i.e., inattention and hyperactivity) are compared separately to the factors of the MMQ.

Future research should be focused at validating the MMQ in an operational setting using military personnel (e.g., aviators). This effort will allow researchers and practitioners to gain a better understanding of sopite syndrome and identify differences that may be present between military personnel and civilian populations. Additionally, the predictive ability of the MMQ should be assessed and it is hoped that MMQ scores will be able to predict flight performance during training hops. In the future, it may be possible to identify personnel who are suffering from (or are susceptible to) the effects of sopite and assist these individuals in overcoming the adverse symptoms associated with the syndrome. This information could help select and train individuals for jobs performed in motion environments, incorporate safety protocols that specifically target the adverse effects associated with sopite syndrome, and prevent sopite related accidents.

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APPENDIX

Mild Motion Questionnaire

Mild Motion Questionnaire

"During or just after MILD or NON-SICKENING motions, the following words or phrases apply to me…"

	not at all	a little	moderately	fairly strongly	very strongly
1. content / happy	1	2	3	4	5
2. distant	1	2	3	4	5
3. lazy /unmotivated	1	2	3	4	5
4. weak	1	2	3	4	5
5. lethargic / sluggish	1	2	3	4	5
6. sleepy	1	2	3	4	5
7. apathetic	1	2	3	4	5
8. hard to concentrate	1	2	3	4	5
9. irritable / annoyed	1	2	3	4	5
10. quiet / not communicative	1	2	3	4	5
11. disoriented	1	2	3	4	5
12. headache	1	2	3	4	5
13. calm	1	2	3	4	5
14. fatigued	1	2	3	4	5
15. peaceful	1	2	3	4	5
16. (as if) drugged	1	2	3	4	5
17. distracted / preoccupied	1	2	3	4	5
18. light-headed	1	2	3	4	5
19. soothed	1	2	3	4	5
20. uncoordinated	1	2	3	4	5
21. fuzzy-headed / foggy-headed	1	2	3	4	5
22. tired	1	2	3	4	5
23. dizzy	1	2	3	4	5
24. relaxed	1	2	3	4	5
25. off-balance / wobbly	1	2	3	4	5

"During or just after MILD or NON-SICKENING motions, the following words or phrases apply to me…"

	not at all	a little	moderately	fairly strongly	very strongly
26. shaky / jittery	1	2	3	4	5
27. comfortable	1	2	3	4	5
28. confused	1	2	3	4	5
29. want to be alone	1	2	3	4	5
30. (as if) in a trance/hypnotized	1	2	3	4	5
31. yawning	1	2	3	4	5
32. stomach awareness	1	2	3	4	5
33. drowsy	1	2	3	4	5
34. blurred vision	1	2	3	4	5
35. floating	1	2	3	4	5
36. hard to keep eyes open	1	2	3	4	5
37. pleasurable	1	2	3	4	5
38. bored	1	2	3	4	5
39. disconnected / detached	1	2	3	4	5

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The sopite syndrome is characterized by motion-induced drowsiness. However, little is know about this unique response to motion. The Mild Motion Questionnaire was developed in an effort to quantify sopite syndrome. The goal of the current study was to test the construct validity of the questionnaire to distinquish the symptomology from that of boredom or inattention. Thus, a sample of 456 undergraduate students completed the Mild Motion Questionnaire, the Boredome Proness Scale, and the Adult Attention Deficit/Hyperactive Disorder Checklist. Results suggested divergence of sopite from the other scales. Conversely, the measures of boredom proneness and attention deficit/hyperactive disorder were related. Interpretations and implications for performance and human error in operational settings are discussed as well as implications for performance and human error in operational settings.

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